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ABSTRACT

This study explored questions concerning the specificity of facial expression of emotions in infants. A sample of 27 infants (nine each at ages 10, 11, and 12 months) were tested in six experimental and six control conditions. Two of the experimental conditions were designed to elicit fear, two happiness, and two surprise. Videotapes of the infants' responses were subjected to three different types of rating tasks with different sets of raters assigned to each. The three rating tasks were: assessment of instrumental behaviors indicative of emotional expression; forced-choice identification of infant emotion from facial expression alone; and judging the occurrence of component behaviors in different areas of the face. Results indicated that: (1) the judges were able to make all infant facial expression judgments reliably; (2) data from instrumental behaviors confirmed that all eliciting circumstances except the stranger approach were successful in producing the desired affective reactions in the infants; (3) forced-choice judgments for the control conditions were accurate with the exception of the visual cliff control episode; (4) forced-choice judgments were very accurate for happiness but not for the other experimental conditions; and (5) except for happiness, few of the facial expression components differentiated between experimental and control conditions. (JMB)

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Fear, Surprise and Happiness:

The Patterning of Facial Expression in Infants

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Fear, Surprise, and Happiness

The Patterning of Facial Expressions in Infants

This report deals with three questions centering on the issue of the specificity of facial expressions of emotions in human infants:

First, can adult judges reliably agree on what emotion an infant is expression on the basis of facial expressing alone (independently of any contextual information)?

Secondly, what is the convergent and discriminant validity of facial expression judgments in infancy? That is, will circumstances designed to elicit different emotional states in fact produce different facial expressions, and will circumstances designed to produce the same emotional state produce the same facial expression?

Thirdly, what are the response components in the infant's face that reliably change as a function of eliciting circumstance, how do these components correspond to the emotional expression patterns described in prior work as characteristic of specific emotions, and how do they affect judgment of emotional expression made by raters?

Our interest in emotional expression in the infant face is based upon both theoretical and empirical concerns. Facial expression patterns have been postulated by a number of researchers to show a close relationship to specific underlying emotional states (Ekman, 1972; Izard, 1971; Schwartz, Fair, Salt, Mandel, & Klerman, 1976). The existence of such patterns offers a challenge to prevailing theories of emotion which hold that emotional states are based upon undifferentiated states of arousal

(Mandler, 1962; Schachter, 1971). Furthermore, there is an important developmental implication in the findings of cross-cultural studies that facial expressions and their recognition are universal (Ekman, 1972; Izard, 1971). If facial expressions are innate, as these studies imply, the development of such expressions in infancy and afterward may provide critical clues about the operation of maturational factors in emotional differentiation and integration. In addition, there is now abundant evidence that facial behavior patterns not only serve as expression of internal states, but also as salient stimuli with critical nonverbal communication value to social figures, both in infancy (Emde, Katz, & Thorpe, in press; Emde, Kligman, Reich, & Wade, in press) and at later ages (Eibl-Eibesfeldt, 1975).

The present study differs from much of the prior work of facial expressions in a number of ways, the most significant being the elicitation of situationally-induced emotions. We hoped in this way to extend the conclusions of prior adult work, which was based largely on studies of actor-posed facial expressions. Another difference was that this study used infants from 10-12 months of age, thereby attempting to determine whether the careful identification of facial expression patterns described by Ekman and Izard in adults also applied to infants. Thirdly, we incorporated a number of methodological features not often used in studies of infant facial expressions. One critical feature was the videotaping of facial expressions in such a way that judges saw no contextual cues to provide them with extra-facial information on eliciting circumstances. We also devised

control conditions for each of our emotion-eliciting situations to allow assessment of facial expressions in situations which should have elicited no emotion. Finally, we verified whether the situations we used elicited an emotion in the subjects tested; that is, we assessed independently of facial expression scoring, presence or absence of instrumental behaviors presumably indicative of the appropriate affect.

We tested 27 infants (14 male, 13 female), nine at each of 10, 11, and 12 months of age. Two situations (the entry and close approach of a stranger, and placement atop the deep side of the visual cliff) were designed to elicit fear. Two (a peek-a-boo game, and a collapsing toy game) were designed to elicit happiness. Two (a vanishing object task devised by Bower, 1967, and a toy-switch task based on Ramsay & Campos, 1975) were designed to elicit surprise. Infants were brought to the lab on two separate days for testing, with one of each of the three emotion situations being presented each day. The order of testing on each day was counterbalanced across subjects.

The description of the six experimental situations and their appropriate control conditions are presented in Table I.

Insert Table I about here

There were three different rating tasks, with different sets of raters assigned to each. One task involved the assessment by two raters of instrumental behaviors indicative of emotional expression. (These behaviors are listed in Table 1.) A second task involved a forced-choice judgment,

also by two raters, of what emotion the infant was expressing from a list of the six emotions designated as "primary" by Ekman (i.e., fear, sadness, disgust, happiness, surprise, and anger), plus a seventh category--neutral emotion. The same judges also rated how confident they were, on a 9-point scale, that each of the emotion categories was being expressed. Finally, three raters judged the occurrence or non-occurrence of component facial behaviors scored from three regions of the face: the eyebrow-forehead region, the eyes-eyelid region, and the nose-mouth region. The components scored were similar to those described by Ekman (1972; Ekman & Friesen, 1975), and were scored while only the particular facial region was in view (the others being blacked out during the rating period). Except for the surprise situations, rating tasks involved 15 sec segments beginning 5 sec before event onset. Surprise involved only 10 sec segments, but also began 5 sec before event onset.

Our results were as follows:

1. The judges were able to make all facial expression judgments reliably. Percentages of perfect agreement for global judgment of the presence and absence of a specific emotion was 90% (range: 81-96%). Correlations of confidence ratings were also high, the median being .83 (range: .72-.92). Interestingly, for the very exacting task of judging the presence and absence of facial expression components, we obtained a reliability of 77% for perfect agreement. Judgments of instrumental behaviors also were made reliably with inter-rater correlations averaging .92.

2. Data from instrumental behaviors confirmed that all eliciting circumstances, except the stranger approach, were successful in producing the desired affective reactions (i.e., a significant number of subjects avoided the deep side of the visual cliff, searched for the vanishing toy, attempted to reactivate the peek-a-boo game, etc.).

3. Figure 1 represents the data for the forced-choice task when judges rated the six control conditions. Global judgments fell, as expected, overwhelmingly into the neutral category with the signal exception of the visual cliff control. Evidently, approaching the deep side of the cliff, even when it is partially covered by a cloth, can elicit some emotional reaction in infants.

Insert Figure 1 about here

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4. Figure 2 represents the equivalent forced choice emotion judgments for the experimental conditions. Note the ease with which happiness is discriminated, with almost all subjects being rated in the appropriate category. However, global emotion judgments for the other four situations were much less discriminating. For example, although the modal judgment for the visual cliff was fear, as predicted, fear was chosen for only a minority of subjects and was not significantly different from the number of subjects rated as neutral.

Insert Figure 2 about here

The vanishing object task also produced a modal rating of surprise, but neutral emotion judgments were given to a large proportion of the subjects tested. For two conditions, the toy switch and the stranger episode, neutral emotion was the modal category.

The analysis of variance of the 9-point confidence ratings thoroughly confirmed the pattern of findings obtained with the forced choice method. Highly significant interaction between Emotions, Experimental vs. Control conditions, and Rating Categories was obtained, ($F=59.75$, $p<.0001$,) but follow-up analyses revealed that the Happiness ratings were entirely responsible for these effects. No comparison between any of the other four experimental conditions and their appropriate control situations reached statistical significance. Consistent with much previous research (Ekman, 1972; Schwartz et al., 1976), the present findings demonstrate that judgments of happiness can be made from facial expressions with much greater resolution and confidence than can judgments of fear and surprise from facial expressions.

5. Table 2 represents the components scored in all experimental and control conditions for the three areas of the face. Figures 3a, 3b, and 3c represent the facial expression components rated for all conditions. As can be seen except for happiness, few of the Ekman facial expression components differentiated between experimental and control conditions. The components scored correspond to those listed in Table 2.

Insert Table 2 about here

Insert Figures 3a, 3b, and 3c about here

The results we have just presented raise a critical question about infant facial expressions. Why is it that despite good agreement between judges rating emotion from facial expressions, only happiness is reliably and confidently discriminated in our testing situations? One hypothesis is that the emotion-eliciting conditions in fact did not work. However, the instrumental behaviors recorded separately from facial expressions did not support this hypothesis. On the visual cliff, for example, 26 of 27 subjects showed clear behavioral aversion to crossing the deep side of the cliff, yet 7 of these 26 subjects were rated as having a NEUTRAL facial expression! In the toy-switch condition 24 of 27 infants tested showed behavioral evidence of surprise (i.e., extended looking and visual search), but of these, 11 were rated as having a neutral facial expression. Although smaller proportions of subjects showed behavioral evidence of fear of the stranger, or of surprise at the vanishing object, we again found that significant proportions of infants who showed the instrumental behaviors indicative of affect were rated as having neutral facial expressions. There can be no doubt that infants behaviorally expressing affect need not be communicating it via the face.

Consequently, we at present favor a second hypothesis: Except for happiness, we feel that it may be difficult to elicit facial expressions in infants in the thoroughly integrated and patterned fashion that Izard and

Ekman have described for adults. This hypothesis does not rule out the possibility that an isolated infant, under certain circumstances, can be shown to possess the integrated pattern communicative of one or another of the fundamental emotions. However, our components analysis suggests that at the ages we tested, such is not likely to be the rule. What we observed was that the happiness-eliciting situations produced facial component patterns with a high signal-to-noise ratio. That is, components indicative of happiness were generally present in most subjects, and components indicative of the other primary emotions were generally absent. By contrast, the other two pairs of situations elicited facial component patterns with less signal and more noise. That is, some of the facial components indicative of surprise or fear were absent in all or nearly all subjects, and others present in but a small proportion of subjects, while at the same time a number of components of emotions other than fear or surprise were present. Because judges were generally able to predict the emotion by facial expression in the forced choice task, we feel that it is not that infant facial expressions are undifferentiated, but that total integration into a specific pattern is absent.

In conclusion, then, our study demonstrated that:

1. Adult judges can reliably rate infant facial expressions of emotions from facial behavior alone.

2. There is a certain degree of specificity of emotional expression in the infant face, but the specificity is clear only for happiness in this study.

3. A number of critical response components of facial expressions were not elicited in most subjects in the present study, and at the same time a number of other response components were observed.

4. It remains for future work to determine at what ages the hypothesized facial patterns become integrated in the human child.

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Table 1

	Experimental Condition	Control Condition
Surprise--Toy Switch	Infant removes cover and finds different toy from the one seen hidden.	Infant removes cover and finds same toy as the one seen hidden.
Surprise--Vanishing Object	Large tachistoscope-like apparatus makes object appear to vanish from view.	Identical objects in two fields of tachistoscope so that object does not appear to vanish.
Happiness--Peek-a-Boo	Mother hides behind large cloth and emerges, saying "peek-a-boo" to baby.	15 sec period immediately prior to playing game.
Happiness--Collapsing Toy	Mother activates a Walt Disney toy which totally collapses and pops back up alternately.	15 sec period prior to interaction
Fear-Stranger Approach	The 15 sec intrude phase of the entry and approach of a female adult stranger. Stranger is within .3 m of infant.	Mother, avoiding eye contact with infant, moves a chair within 2.5 of infant.
Fear--Visual Cliff	Direct placement atop the deep side of the visual cliff.	Direct placement atop a portion of the visual cliff which has a 1.8 m by 0.7 m black felt screen immediately under it to create a visually solid surface, yet allow video taping of face.

Instrumental Behavior Indicative of Appropriate Affect
Greater duration of looking at the different toy.
Greater duration of looking into the tachistoscope after toy vanished.
Attempts to reactivate the peek-a-boo game.
Attempts to reactivate the toy game.
Presence of crying, gaze aversion, or backing away from stranger.
Failure to cross the deep side of the cliff to the mother despite being coaxed to do so.

Table 2

Components Scored

Eyebrow/Forehead

1. The brows are raised so that they are curved and high.
2. The brows are raised and drawn together.
3. The brow is lowered, lowering the upper lid.
4. Horizontal wrinkles go across the forehead.
5. The brows are lowered and drawn together.
6. The wrinkles in the forehead are in the center, not across the entire forehead.
7. The inner corners of the eyebrows are drawn up.
8. Vertical lines appear between the brows.
9. The skin below the brow is stretched.
10. The skin below the brow is triangulated, with the inner corner up.

Eyes/Lids

1. The upper eyelid corner is raised.
2. The eyelids are opened; the upper lid is raised and the lower lid is drawn down (the white of the eye-sclera shows above the iris, and often below as well).
3. The lower eyelid shows wrinkles below it, and may be raised but not tense.
4. The eyes have a hard stare and may have a bulging appearance.
5. The upper lid is raised, exposing sclera, and the lower lid is tensed and drawn up.
6. The lower lid is tensed and may or may not be raised.
7. Crow's-feet wrinkles go outward from the corners of the eyes.
8. The upper lid is tense and may or may not be lowered by the action of the brow.

Nose/Mouth

1. The corners of the lips are drawn back and up; the teeth may or may not be exposed.
2. The mouth is open an the lips are either tensed slightly and drawn back or stretched and drawn back.
3. The upper lip is raised.
4. The lips are in either of two basic positions; pressed firmly together with the corners straight or down, or open, tensed in a squarish shape as if shouting.
5. The lower lip is raised and pushed up to the upper lip, or is lowered and slightly protruding.
6. The corners of the lips are down or the lip is trembling.
7. The jaw drops open so that the lips and teeth are parted, but there is no tension or stretching of the mouth.
8. A wrinkle (the naso-labial fold) runs down from the nose to the outer edge beyond the lip corners.
9. The cheeks are raised.
10. The nose is wrinkled.

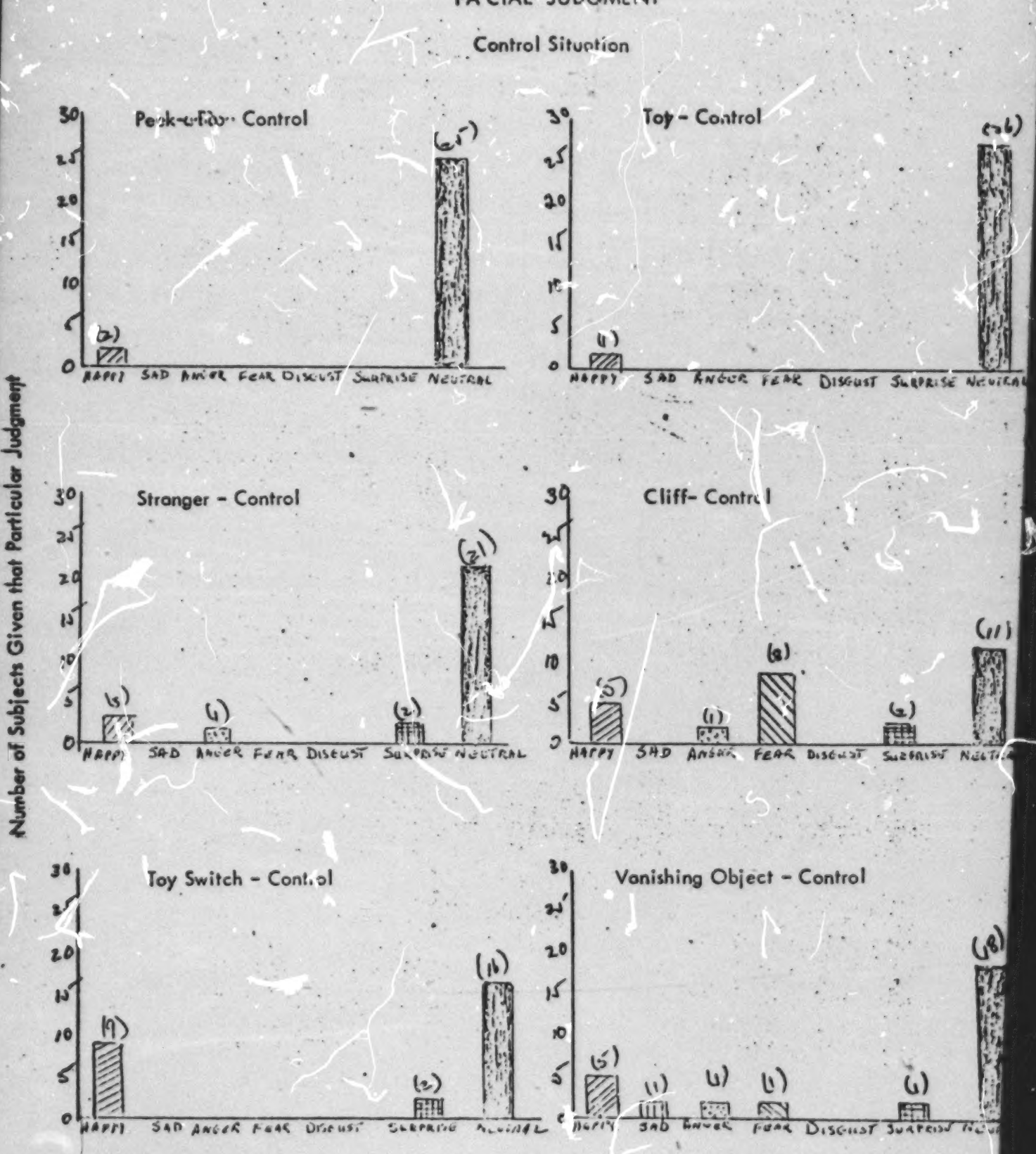

Fig. 1. Number of sujects chosen as expressing each emotion category in control condition.

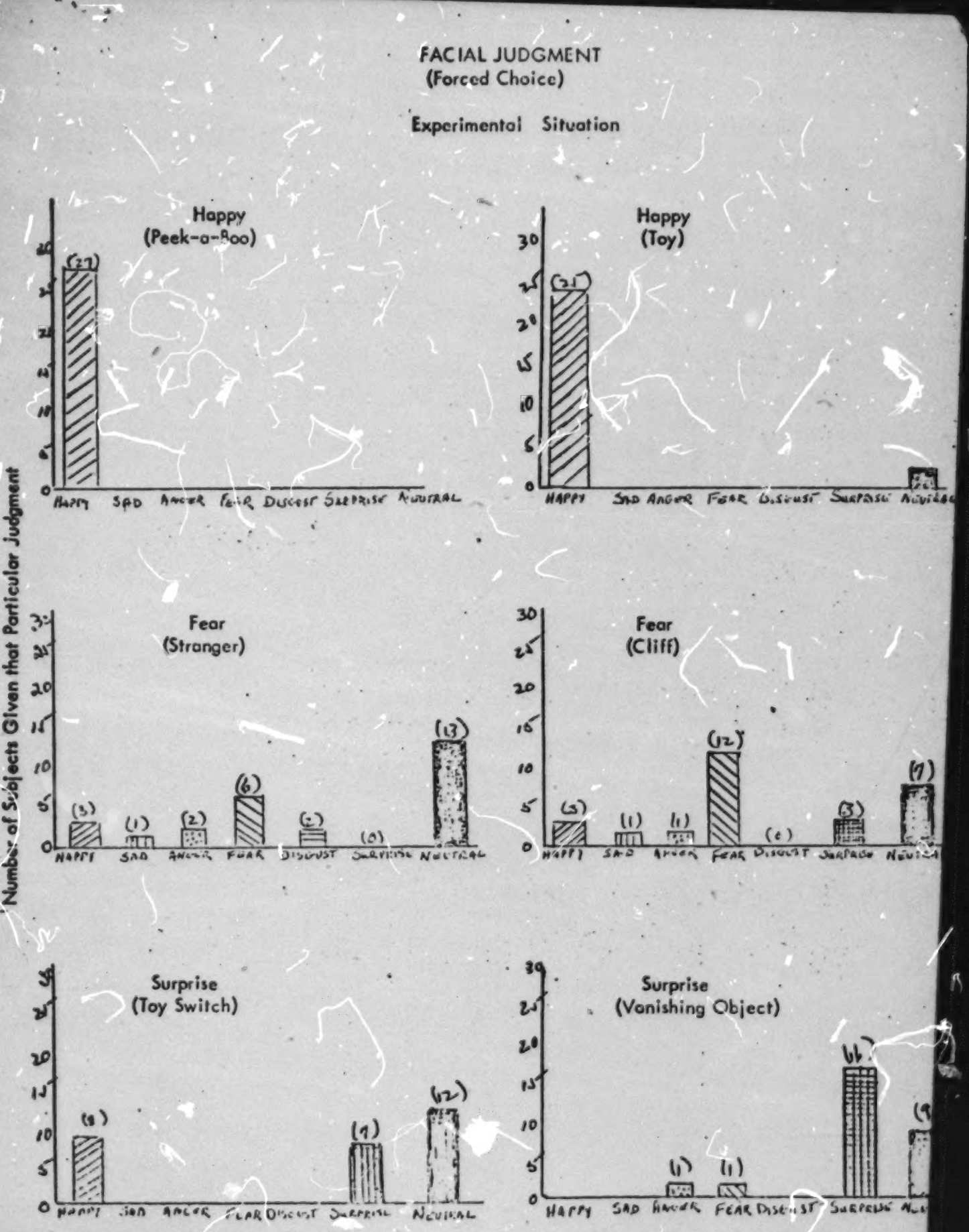

Fig. 2. Number of subjects chosen as expressing each emotion category in experimental condition.

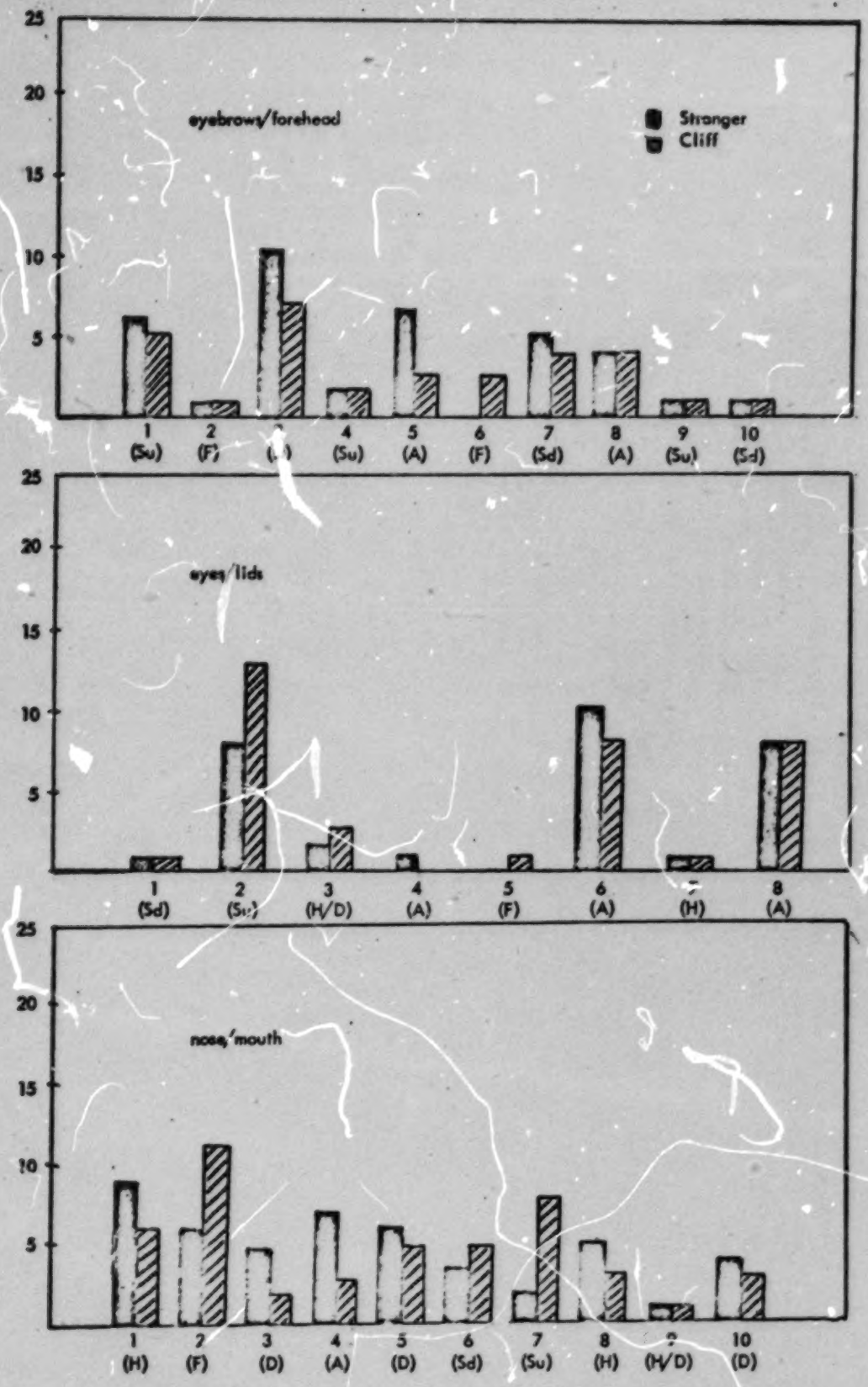

Fig. 3a. Number of subjects expressing each facial expression component in Fear situation. Numbers refer to component described in Table 2. Letters refer to emotion linked to the components.

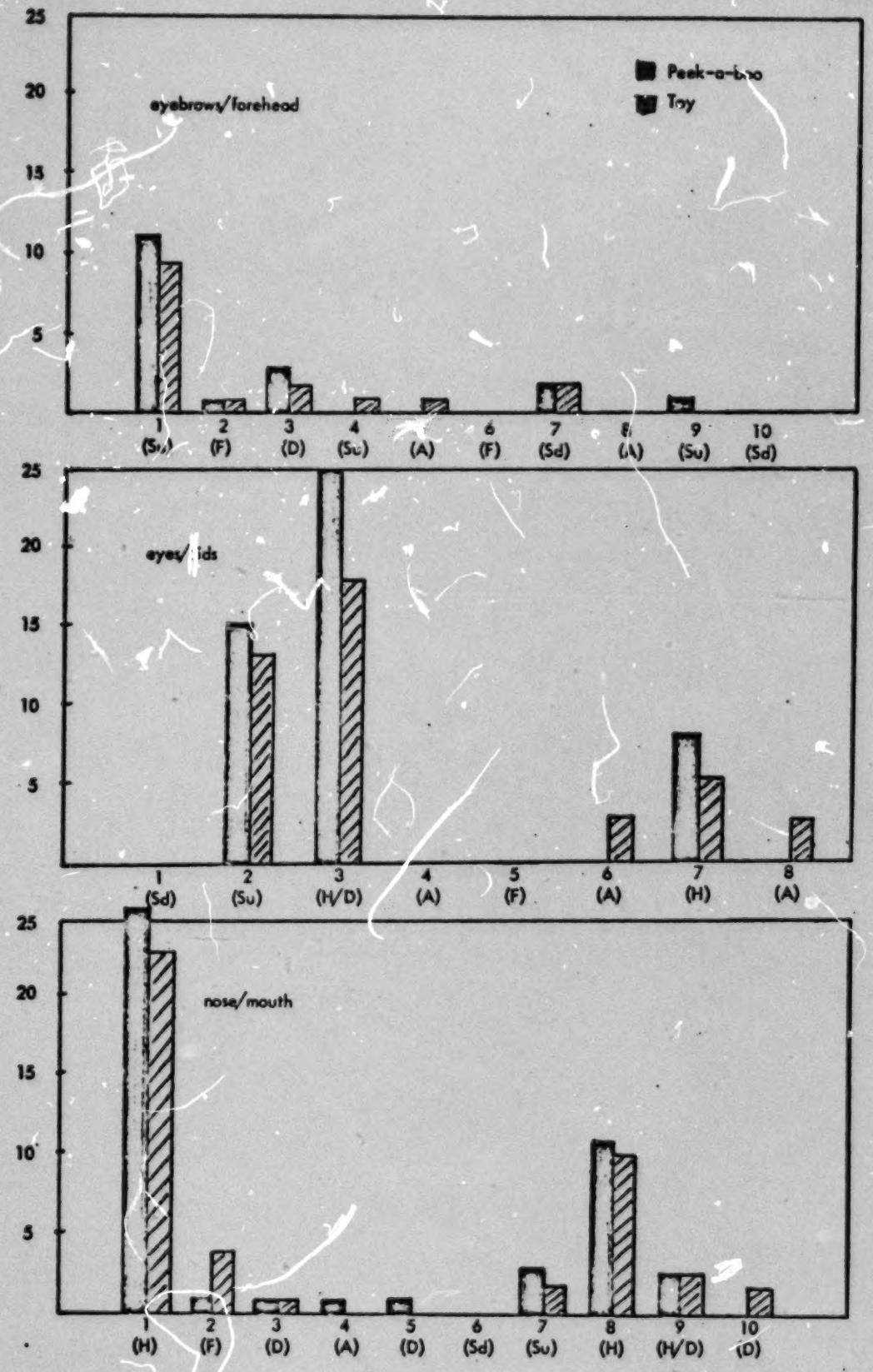
Peek-a-boo
Toy
eyebrows/forehead
1 (Su) 2 (F) 3 (D) 4 (Su) 5 (A) 6 (F) 7 (Sd) 8 (A) 9 (Su) 10 (Sd)
eyelids
1 (Sd) 2 (Su) 3 (H/D) 4 (A) 5 (F) 6 (A) 7 (H) 8 (A)
nose/mouth
1 (H) 2 (F) 3 (D) 4 (A) 5 (D) 6 (Sd) 7 (Su) 8 (H) 9 (H/D) 10 (D)
25
20
15
10
5

Fig. 3. Number of subjects expressing each facial expression component in Happiness situation. Numbers refer to component described in Table 2. Letters refer to emotion linked to the components.

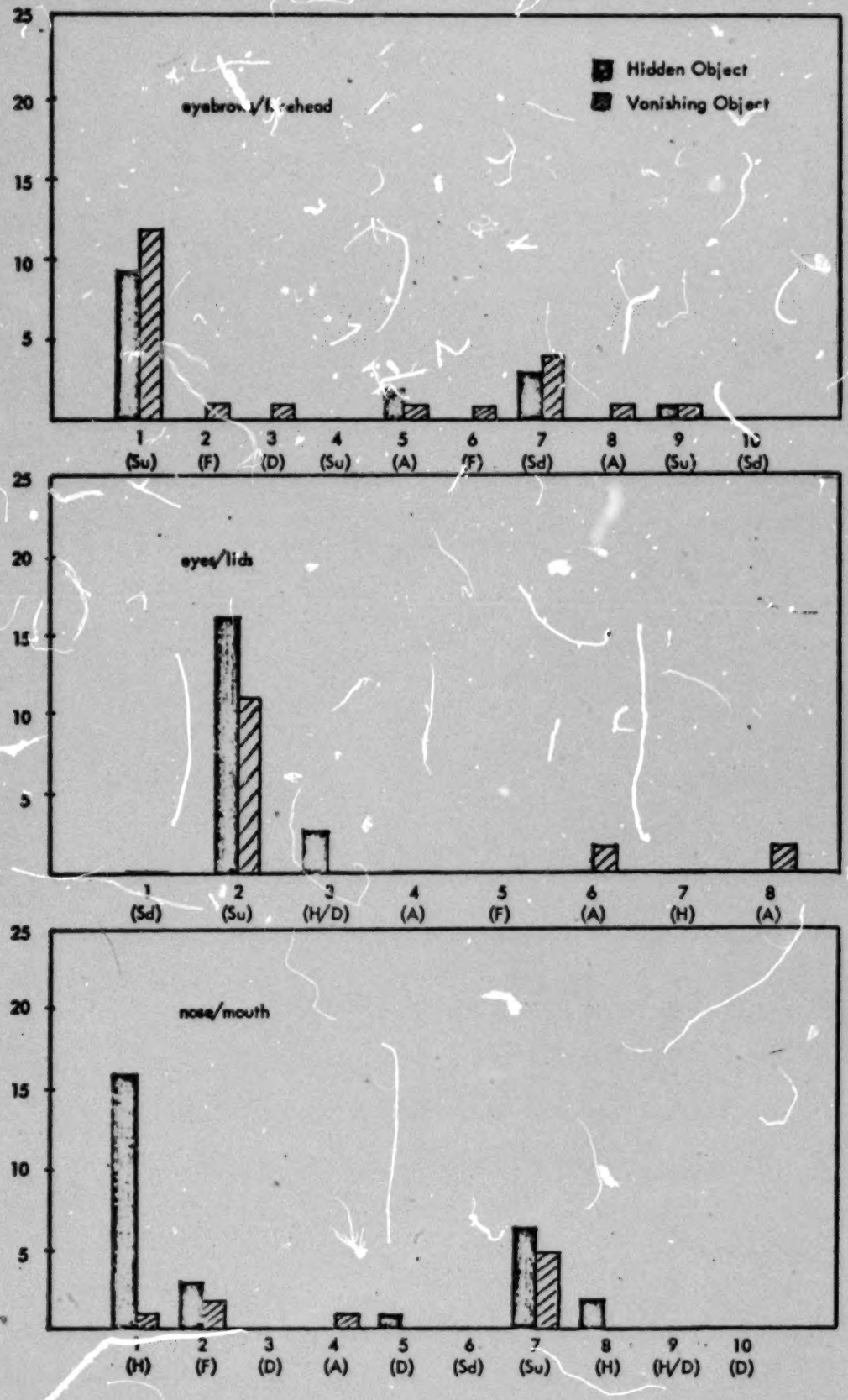

Fig. 3c. Number of subjects expressing each facial expression component in Surprise situation. Numbers refer to component described in Table 2. Letters refer to emotion linked to the components.